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学　位　論　文　要　旨

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題目: Studies on the effects of vegetation factors on biological soil crust cover, and the spatio-temporal patterns of ectomycorrhizal fungal communities of Quercus liaotungensis in the Loess Plateau, China

（中国黄土高原におけるバイオクラストの被度に植生が与える影響、および外生菌根菌群集の時空間的な動態に関する研究）

Abstract: The Chinese Loess Plateau is an ecologically fragile area, with serious soil and water erosion and severe the fragile ecological environment, and faces a series of severe and highlighted ecological environment problems. In order to rehabilitate and reconstruct a healthy, stable and sustainable ecosystem of the Loess Plateau, it is necessary to give a full consideration to the whole ecosystem of this region. However, to date there also has some biological components which play essential ecological functions, and were rarely investigated including biological soil crusts (BSCs) and ectomycorrihzal fungi (EMF) communities. The objectives of this research were mainly related to scientific problems of BSCs and EMF communities.

To elucidate the influence of changes in vegetation factors on BSC cover during vegetation secondary succession in rehabilitated grasslands which succession process was related to the “Grain for Green” project implemented in the Loess Plateau region in 1999, Chapter 2 studied the relationship between vegetation factors and BSC cover in three seral rehabilitated grasslands: 8-year-old (Q8, *Heteropappus altaicus* + *Artemisia capillaris*), 12-year-old (Q12, *Potentilla bifurca* + *Lespedeza davurica*), and 16-year-old (Q16, *Stipa bungeana* + *Cleistogenes squarrosa*) respectively. The rate of degradation of BSCs underneath litter ($P < 0.01$) and the degradation cover of BSCs ($P < 0.05$) differed significantly between the 8- and 16-year-old successions. Stepwise multiple linear regression analysis showed that the main vegetation factors influencing the dynamics of BSC cover differed among the 8-, 12-, and 16-year-old rehabilitated grasslands. Basal cover, phytomass, and litter cover were the main vegetation factors influencing the dynamics of BSC cover on 8-year-old rehabilitated grassland. Phytomass, litter thickness, and litter cover were the main factors influencing the dynamics of BSC cover on 12-year-old rehabilitated grassland. On 16-year-old rehabilitated grassland, *Pielou* evenness index, litter thickness, and litter biomass were the main vegetation factors influencing degradation of BSC cover underneath litter, whereas basal cover, litter thickness, and litter biomass were the main vegetation factors influencing the degradation cover of BSCs. At particular stages of herbaceous succession, vegetation factors can have a large influence on changes in the community’s basal cover and litter, which are key factors influencing changes in BSC cover. The degradation of BSCs underneath litter may be a result of complicated eco-physiological processes.

To characterize the changes in EMF communities of *Quercus liaotungens* Koidz of different tree age on the Loess Plateau, Chapter 3 investigated EMF communities of *Q. liaotungensis* of three age classes (seedling, young and mature trees) in the central Loess Plateau (Yan’an city, China). By combining morphological and molecular identification methods, I investigated EMF communities of *Q. liaotungensis* of three age classes (seedling, young and mature trees) in the central Loess Plateau (Yan’an city, China): seedling (1–3–yr–old seedlings under *Populus davidiana* stand), young tree (20–30–yr–old *Q. liaotungensis* stand),

and mature tree (50–70–yr–old *Q. liaotungensis* stand). In total, 70 EMF species were observed, and the total richness of estimated species exceeded 100 EMF species. The EMF community was composed of five common taxa (about 7%) occurring all the age classes, and 43 rare taxa (about 61%) only found on single age class. Thelephoraceae, Sebacinaceae, Pezizaceae and Inocybaceae were most species-richness families of *Q. liaotungensis*. EMF richness in young and mature tree was higher than that in seedling. EMF communities were more similar between young and mature trees than between seedling and (young or mature) tree. Nonmetric multidimensional scaling ordinations of the EMF community showed a larger portion of the separation among different age of *Q. liaotungensis*. This study provides a first preliminary insights into the characteristic of the belowground EMF community of *Q. liaotungensi* along different tree ages in a Loess Plateau deciduous oak forest (loess soil, soil pH>8).

To illustrated the relationship between EMF communities of *Q. liaotungensis* and topographic factors on the Loess Plateau, Chapter 4 investigated EMF communities of *Q. liaotungensis* along three local slopes (slopes 1, 2 and 3), with three slope position (upper, middle and bottom) plots of each slope. By combining morphological and molecular identification methods, I investigated the relationship between EMF communities of *Quercus liaotungensis* and topographic factors along local slopes in the temperate oak forest on the Loess Plateau of northwest China. ITS-RFLP analysis revealed a high diversity of EMF taxa (135 taxa) associated with *Q. liaotungensis* along three local slopes. EMF communities among slope sites or slope positions, tended to share major common EMF species which accounted for more than 80% of the total EMF abundance, and showed a diverse distribution which mainly related to rare species. Ordination analyses showed that EMF taxa distribution was significantly correlated with several environmental variables (slope site, slope position, slope gradient and soil C:N). Topography-mediated changes of environmental conditions may be important determinants of the distribution of EMF taxa along local slopes (slope position and slope site) in the central Loess Plateau.

According to above results, BSCs and EMF were two kinds of important biolog ical resources which could not be ignored in the Loess Plateau ecosystem, because they play an important role in improving material circulation, system stability, and ecological s uccession, and so on. Therefore, increasing in the research and the use of these two biol ogical resources, will deepen our understanding of the process of the ecological system a nd positively promote the improvement of the ecological environment on the Loess Platea u, such as through the artificial cultivation of biological soil crust to prevent soil erosion, through the development and utilization of indigenous mycorrhizal reagent to improving the well growth of nursery seedlings and afforestation trees on the Loess Plateau.